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(54) ABSORPTION PRODUCT AND METHOD AND APPARATUS FOR ITS MANUFACTURE

(71) We, MO OCH DOMSJO AKTIEBOLAG, a Swedish body Corporate, of, Fack S-891 01 Ornskoldsvik 1, Sweden, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to an absorption product such as a diaper or sanitary towel.

According to the present invention there is provided an absorption product for personal use including a folded sheet of absorptive material which, prior to folding, has at least a first edge, and second and third edges which converge in a direction away from the first edge, the sheet being folded about first and second spaced apart fold lines which are substantially perpendicular to the first edge, whereby a portion of the sheet between the fold lines is partly overlied by one folded edge part, partly overlied by another folded edge part, and partly overlied by both the folded edge parts, such that the product has a first zone of triple material thickness at one end and a second zone of single material thickness at the other end, the second zone being partly bounded by ridges of double material thickness.

The invention also provides a method of making such a product including the steps of forming the absorptive material sheet on a perforated conveyor to which a partial vacuum is applied and folding the so formed sheet.

Further, the invention provides apparatus fur use in making such a product, such apparatus including a perforated conveyor with at least one set of perforations disposed to define the shape of the sheet of absorptive material and a folder to fold the sheet of absorptive material.

It will be appreciated that the product of the invention has a high absorption capacity in the first zone. The second zone is partly surrounded by ridges and serves to define a space for faeces when the absorption product is used as a diaper.

It has not hitherto been possible to manufacture a diaper of this kind at such a low cost that the disposable character of the diaper could be retained. The reason for this is that with a continuous manufacturing process it is difficult to make the absorption products with portions of different thickness without making the manufacturing apparatus considerably more complicated and expensive. One known diaper design has a thicker end portion, obtained by a local larger accumulation of absorption material. Such a local accumulation is however very difficult to execute with a continuous mass production of diapers, primarily due to the absorption material being as a rule available in bulk (it usually consists of dry defibrated cellulose) and the consequent difficulty of varying the feed to a carrier strip repeatedly and abruptly.

In preferred forms of product according to the invention, the sheet is trapezoidal prior to folding, and the fold lines are substantially perpendicular to the parallel sides thereof. The fold lines can meet the shorter of its parallel sides at its ends, or can intersect respective non-parallel sides. It is preferred that the distance between the fold lines is substantially equal to the distance from each fold line to the adjacent end of said first edge. The sheet of absorptive material is surrounded by liquid permeable textile or sheet material. The product may be enclosed in an envelope of non-woven textile material.

In a preferred method of making the product when it has both the permeable sheet and envelope, the absorptive material sheet is formed on a first perforated conveyor, is transferred to a second perforated conveyer whereat the liquid permeable sheet material is applied and whereon the sheet is folded, and is transferred to a third conveyer whereon the envelope is applied.

Advantageously, in apparatus of the invention, the perforated conveyer has a plurality of sets of perforations, the sets being separate or abutting such that, in use, contiguous sheets of absorptive material are formed.

In order that the invention may be more clearly understood, the following description is given, merely by way of example, with reference to the accompanying drawings, in which:

Figure 1 shows a first embodiment of product of the invention;

Figure 2 shows the product of Figure 1 during a stage in manufacture;

Figure 3 shows a second embodiment of product of the invention;

Figures 4 and 5 show apparatus for the manufacture of the product of Figures 1 to 3;

Figure 6 shows a first modification of the apparatus of Figures 4 and 5; and

Figure 7 shows a second modification of the apparatus of Figure 6.

The exemplary diaper according to the invention shown in Figure 1 consists of an absorption cushion 1 and an envelope 2 surrounding it, the envelope being of non-woven textile material (for illustrative purposes the cushion and the envelope are shown separately). The absorption cushion is generally folded to be rectangular and has been obtained by folding a trapezoidal unit 3 (Fig. 2), consisting of two layers 4, 5 of a wet-strength soft paper and an evenly distributed layer 6 of dry defibrated cellulose between them. The folds have taken place along two parallel fold lines 7 and 8, extending from the ends of the shortest (9) of the parallel sides and extending to the opposite parallel side 10 and at right angles to it.

Due to folding, the diaper has obtained a threefold absorption layer 11 at one end, and a V-shaped faeces space 12 at the other end.

Several modifications of the diaper described above can be imagined, without departing from the idea of the invention. For example, it is not necessary for the folding line in unit 3 to start from the ends of the shortest of the parallel sides. They can quite well start from the non-parallel sides 13, 14 of the unit, although of course, they will be perpendicular to the edge 10. In this case the corners 15 and 16 of the diaper at this end will be chamfered. Such a diaper is shown in Figure 3. The fold lines can also start from between the ends of the shorter parallel side, so that the diaper obtains a correspondingly smaller faeces space. It is not necessary for the absorption cushion 1 to be built up from exactly the material given in the example above, but any suitable material or a laminate can be used. One or both of the material layers 4 and 5 can comprise a non-woven textile material possibly laminated with a wet-strength soft paper. One can use a similar laminate for the envelope 2, or wet-strength soft paper only. It is also possible to arrange a trapezoidal layer of absorption material directly in the envelope 2, folded in the above-mentioned way which has the capacity of retaining in itself. It is also possible to have the trapezoidal absorption material according to Figure 2 provided with a layer of soft paper or similar on only one side. The absorption material can naturally be treated with substances to increase its absorption capacity. It is also possible to treat or to form the material layers and/or the envelope to increase the spreading effect in them.

Figures 4 to 7 shows various forms of apparatus according to the invention.

In a preferred embodiment the apparatus comprises a metering arrangement 17 (see Fig. 4) by which dry defibrated cellulose 18 is supplied to an endless conveyor belt 19 in a comparatively even layer. Above the conveyor belt 19 a roller 20 is arranged to even off the cellulose on the conveyor belt. In front of the off-loading end of the conveyor belt a pin-drum 21 is arranged, with which the mass fed out from the conveyor belt is shredded and spread over the adjacent cylindrical surface of a conveying drum 22. The conveying drum 22 consists of a rotatably journalled cylinder sealed at both ends, the cylindrical surface of which is provided with a row of perforated areas 24 separated from each other at an even pitch. Each area has the form of a trapezium with the parallel sides parallel with the rotating shaft 25 of the drum. The areas 24 are arranged in relation to each other so that adjacent areas in the row are opposite hand to each other.

The inside of the drum is divided into two compartments 26 and 27 airtightly separated from each other, which extend between the shaft, ends and cylindrical surface and contain a volume corresponding to 260 and 100 degrees respectively of the circumference. The compartments which do not rotate with the drum are so arranged that the separating walls 28 and 29 between them are directed vertically downwards from the shaft 25 and slopingly upwards towards the conveyer belt 19 respectively. The shaft 25 is provided with a channel which extends from the one shaft end to the largest of the compartments 26.

Where the channel reaches the shaft end it is connected to a vacuum fan, which *via* the channel maintains a constant partial vacuum in the compartment 26. At the other end the drum is connected to a motor for driving the shaft. The channel, vacuum fan and driving motor are of conventional design and are not shown in the Figures.

During rotation of the drum it is supplied with material from the conveyor belt 19 by the pindrum 21 over chiefly the whole of the part of the cylindrical surface which passes the pindrum. However, due to partial vacuum in the compartment 26, the material is concentrated to the areas 24 passing by, this taking place to such an extent, that only a small amount becomes attached to the

cylindrical surface outside the areas. The material outside the areas where there is no such suction force is removed from the drum by a sweeping device 30, placed adjacent to the cylindrical surface, and rotation of the device provides a stream of air intended for this purpose. The absorption layers sucked fast onto the areas 24 are denoted 23 in the Figures.

Under the drum 22 there is an endless perforated conveyor belt 31 on which two strips 32 and 33 of a wet-strength soft paper are fed in the direction of their length with the help of a driving roller 34. Between the two parts of the conveyer belt 31 a suction box 35 is arranged and extends between an area directly in front of the separating wall 28 of the drum and to the middle of the conveyor belt 31. The strips 32 and 33 are driven with a speed corresponding to the peripheral speed of the drum 22. A spill-plate 48 of Plexiglass (Plexiglass is a Trade Mark) is arranged immediately above the conveyor 31 and adjacent to the drum 22 where falling excess absorption material is collected.

As the absorption layers 23 sucked onto the areas 24 pass by the separating wall 28 on the rotation of the drum, the partial vacuum in compartment 26 ceases to affect them, at the same time they are exposed to the sucking action from the suction box 35 through the air permeable soft paper strip 32. Hereby and due to their own weight the absorption layers are transferred to the soft paper strip. As the speed of the soft paper strip is the same as the peripheral speed of drum 22, the absorption layers have the same positions in relation to each other on the soft paper strip as they had on the drum. This means that the parallel sides on each absorption layer are directed at right angles to the length of the strip, and that adjacent absorption layers are opposite hand to each other. When the absorption layers during transport on the soft paper strip 32 arrive at the soft paper strip 33 they slide underneath this, after which they are transported together with both the strips to a folding device 36 placed above the conveyor. During passage through the folding device the strips and absorption layer are folded by it along two lines parallel with the conveying direction, which extend through the ends of the shortest of the parallel sides of the absorption layers (see also Figures 1 and 2). The strips 32, 33 and the absorption layers 23 thus folded are referred to in what follows as strip 37.

A belt conveyor 38 with a driving and pressing roller 39 arranged above it (see also Figure 5) is arranged at some distance from the conveyor 31 and in its conveying direction. A strip 40 of a non-woven textile material is pulled from underneath between the conveyers 31 and 38 together with the strip 37 coming from conveyor 31 further onto the conveyor 38. In the present example the strip 40 is about 2½ times as wide as the strip 37. During transport on the conveyor 38 the strips 37 and 40 pass through a folding device 41, by which the strip 40 is folded around the longitudinal sides of strip 37, and the folded edge portions are overlapped on the upper side of strip 37. Immediately before the edge portions of strip 40 are overlapped, melted binder from a jet 42 placed on the folding device is fed to the lower edge portion. From the folding device the strips are led further in under the driving and pressing roller 39, which seals the overlapped edge portions. After sealing, the strips 37 and 40 are impressed and cut off between the absorbing layers by a heat impressing and cutting-off device 43 at the unloading end of conveyor 38. The cut-off diapers 44 which are now ready, are born further along a sliding plate 45 to a packing station.

The principle of suction applied to the trapezoidal absorption cushion can also be used with a conveyor belt rather than a rotating cylinder. A similar second embodiment of the present method and device is shown in Figure 6. In this modification the soft paper strip 32 is fed with the cellulose directly from the metering device 17. With this design the conveying drum 22 is not present. Instead the belt-conveyor 49 on which the soft paper strip 32 is conveyed is provided with a row of separated trapezoidal and perforated areas 46 with the same function and common distance as the areas 24 on the drum 22 in the first embodiment. The suction box for the conveyor 49 extends in this case between the rear end pulley of the conveyor 49 and its middle. At a distance from the metering device 17, in the direction of transport there is a sweeping device 30 arranged above the conveyor 49, by which the material outside the areas and not affected by the suction force is removed from the soft paper strip 32. After the absorption layer 23 has been formed on the soft paper strip 32 in this way over the areas 46, manufacture takes place in the same way and with the use of the same sort of devices as in the first embodiment. In a third embodiment of the present method and device which is shown in Figure 7, the metering device 17 feeds the cellulose directly onto the soft paper strip 32 in the form of a cohesive band 47 of cellulose. The conveyor 50 for the soft paper strip 32 is in this case is provided with a single elongated perforated area 48. This area extends over the length of the conveyor belt and has the form of trapezoids placed against one another, the parallel sides of which are at right angles to the direction of transport. Adjacent trapezoidal areas on the belt are at opposite hand. On the supply of cellulose from the metering arrangement 17, the main part of the material is sucked fast

on to the perforated area 48 covered by the soft paper strip 32. The material not affected by the sucking force and which falls onto the soft paper strip is removed with the help of the sweeping device 30. Thus the remaining material on the soft paper strip obtains the same form as the area 48.

After a second soft paper strip 33 has been brought over the substance band 47, both the soft paper strips and the substance band laying between are folded in the same way as in the first embodiment. After folding, the soft paper strips and the substance band are cut along the parallel sides corresponding to the trapezoidal shape of the area 48. The cut-off units are separated by transference to a high speed belt conveyor not shown in the Figure. Continued manufacture takes place afterwards in the way already described with respect to the first embodiment.

Several further modifications of the described method and device can occur without departing from the idea of the invention. Several layers of water permeable material or laminations thereof can for example be arranged under and possibly also over the absorption layers. This can take place before and/or after the first folding operation in the manufacturing process. The devices required for this can be conventional and are not described.

The absorption body produced according to the invention has the advantage of having a thicker end portion, which is especially suitable for sanitary towels, which normally receive the greatest amount of liquid in the front end. Another advantage with the absorption body is that its thinner end portion forms a space bounded by V-shaped edges, which serve as faeces space when the absorption body is used as a diaper.

WHAT WE CLAIM IS:—

1. An absorption product for personal use including a folded sheet of absorptive material which, prior to folding, had at least a first edge, and second and third edges which converge in a direction away from the first edge, the sheet being folded about first and second spaced apart fold lines which are substantially perpendicular to the first edge, whereby a portion of the sheet between the fold lines is partly overlied by one folded edge part, partly overlied by another folded edge part, and partly overlied by both the folded edge parts, such that the product has a first zone of triple material thickness at one end and a second zone of single material thickness at the other end, the second zone being partly bounded by ridges of double material thickness.

2. A product according to claim 1 wherein the sheet is trapezoidal prior to folding, and the fold lines are substantially perpendicular to the parallel sides thereof.

3. A product according to claim 2 wherein the fold lines meet the shorter of the parallel sides at its ends.

4. A product according to claim 2 wherein the fold lines intersect respective non-parallel sides of the trapezoidal sheet.

5. A product according to any preceding claim wherein the distance between the fold lines is substantially equal to the distance from each fold line to the adjacent end of said first edge.

6. A product according to any preceding claim wherein the sheet of absorptive material is surrounded by liquid permeable textile or sheet material.

7. A product according to claim 6 wherein the liquid permeable sheet material is paper.

8. A product according to any preceding claim enclosed in an envelope of non-woven textile material.

9. An absorption product for personal use substantially as hereinbefore described with reference to and as illustrated in Figures 1 and 2 of the accompanying drawings.

10. An absorption product for personal use substantially as hereinbefore described with reference to and as illustrated in Figure 3 of the accompanying drawings.

11. A method of making a product as claimed in any preceding claim including the steps of forming the absorptive material sheet on a perforated conveyor to which a partial vacuum is applied and folding the so formed sheet as set out in claim 1.

12. A method according to claim 11 wherein the product is enclosed in an envelope after folding.

13. A method according to claim 11 or 12 wherein the sheet is enclosed whtin a liquid permeable textile or sheet material prior to folding.

14. A method according to claim 11 and 12 and 13 wherein the absorptive material sheet is formed on a first perforated conveyor, is transferred to a second perforated conveyor whereat the liquid permeable sheet material is applied and whereon the sheet is folded, and is transferred to a third conveyor whereon the envelope is applied.

15. Methods of making a product as claimed in any one of claims 1 to 10 substantially as hereinbefore described with reference to Figures 4 to 7 of the accompanying drawings.

16. Apparatus for use in making a product as claimed in any one of claims 1 to 10, such apparatus including a perforated conveyor with at least one set of perforations disposed to define the shape of the sheet of absorptive material and a folder to fold the sheet of absorptive material as set out in claim 1.

17. Apparatus according to claim 16 including a plurality of sets of perforations, each set being separated.

18. Apparatus according to claim 16

including a plurality of sets of perforations, and wherein the sets abut such that, in use, contiguous sheets of absorptive material are formed.

19. Apparatus according to claim 16, 17 or 18 wherein the conveyor is a drum.

20. Apparatus according to claim 16, 17 or 18 wherein the conveyor is an endless belt.

21. Apparatus according to any one of claims 16 to 20 including a second conveyor to which sheets of absorptive material can be transferred, and means associated with the second conveyor to enclose the sheets in a layer of liquid permeable textile or sheet material, the folder being downstream of said means.

22. Apparatus according to any one of claims 16 to 21 including a further conveyor downstream of the folder, and means associated with the further conveyor to enclose the folded sheets in envelopes of liquid permeable material.

23. Apparatus for use in making a product as claimed in any one of claims 1 to 10, such apparatus being constructed and arranged substantially as hereinbefore described with reference to and as illustrated in Figures 4 and 5 of the accompanying drawings.

24. Apparatus according to claim 23 modified substantially as hereinbefore described with reference to and as illustrated in Figure 6 of the accompanying drawings.

25. Apparatus according to claim 24 modified substantially as hereinbefore described with reference to and as illustrated in Figure 7 of the accompanying drawings.

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Fig. 1

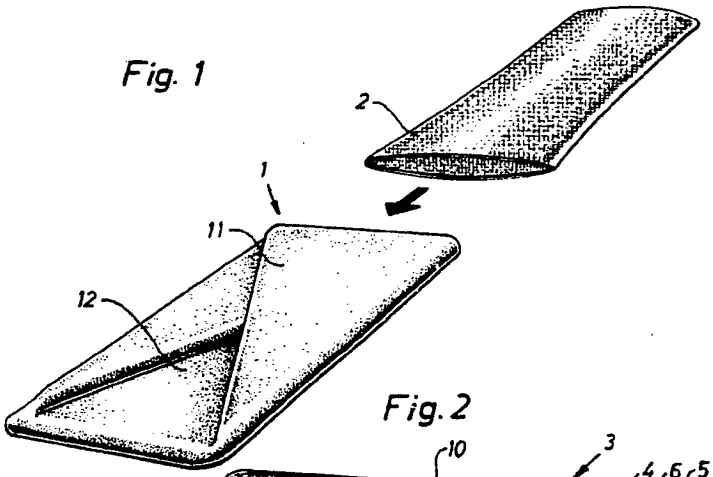


Fig. 2

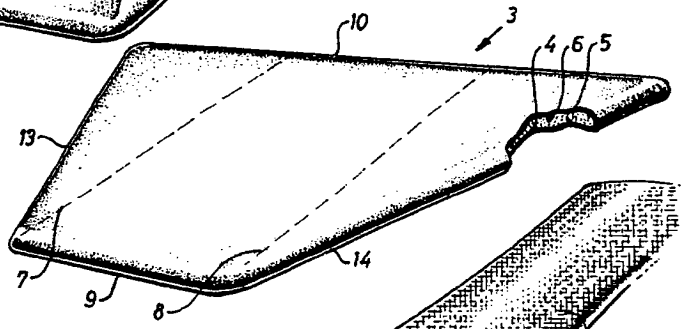
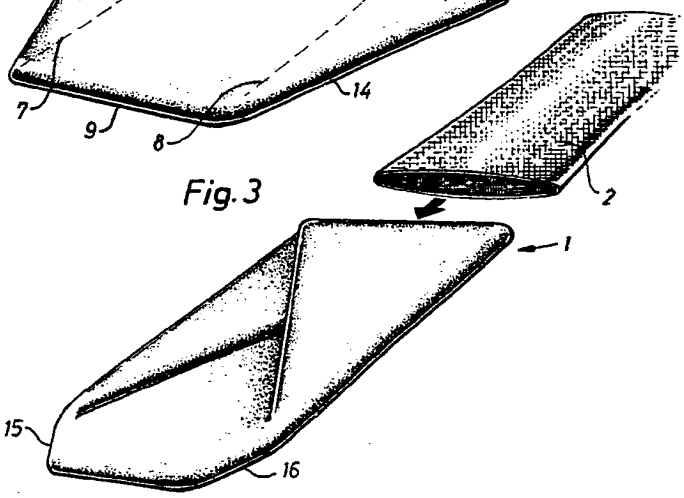


Fig. 3



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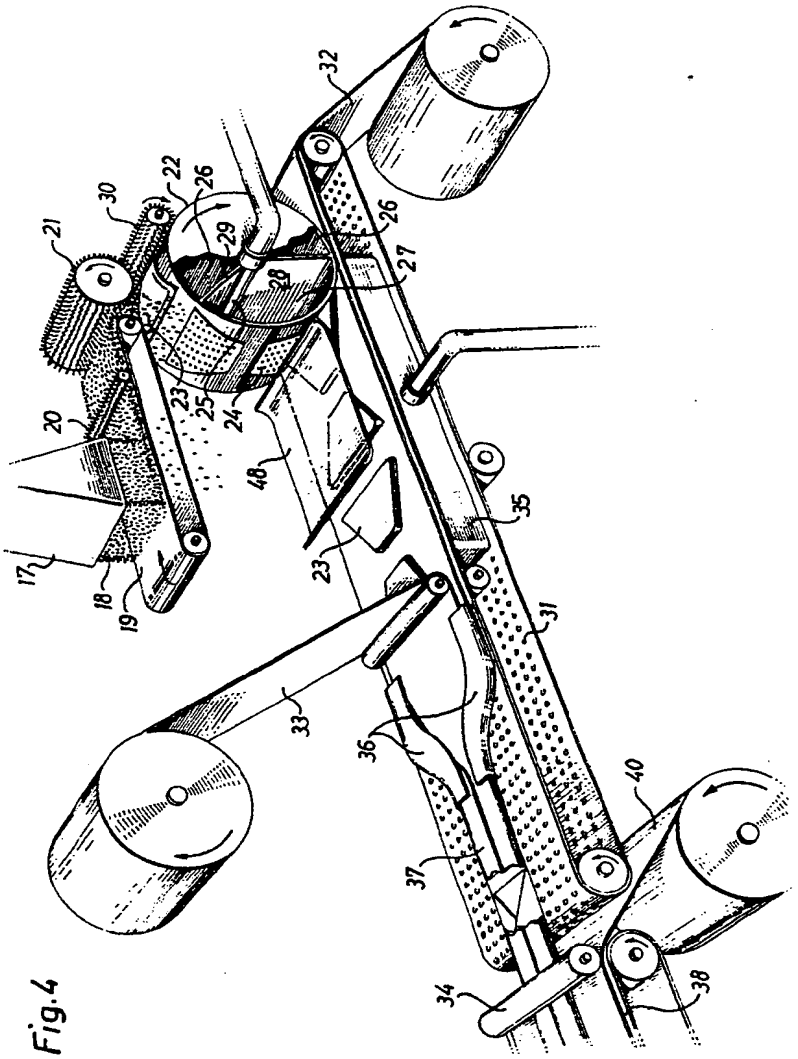

Fig.4

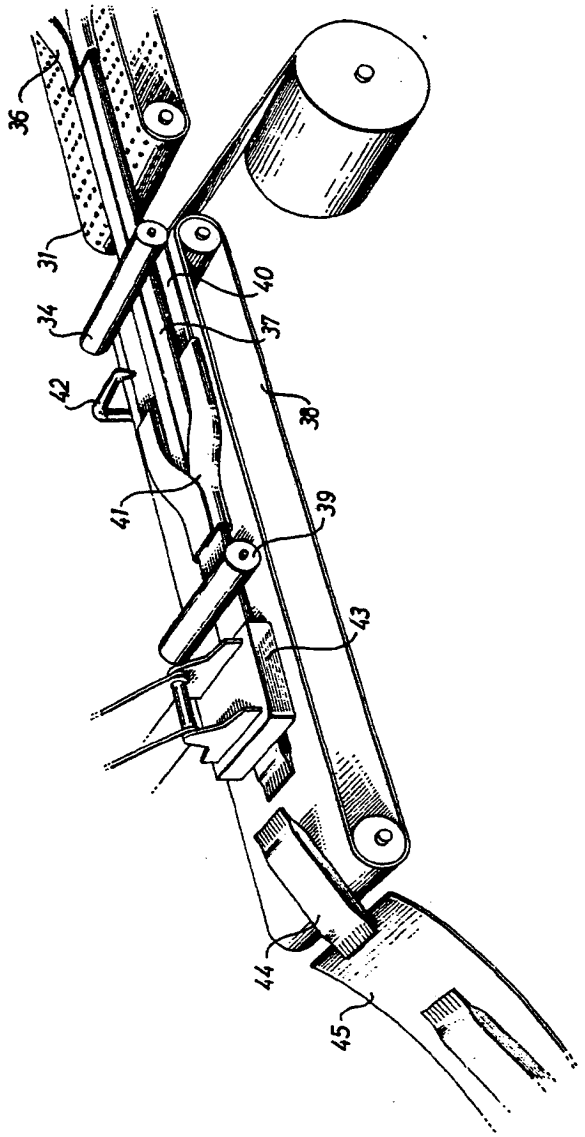

Fig. 5

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Sheet 4

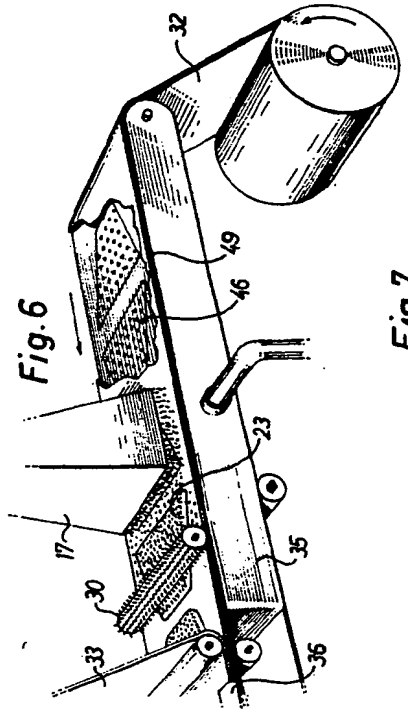

Fig.6

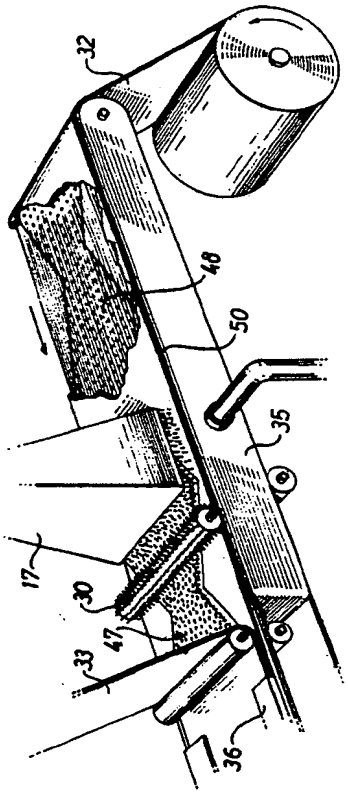

Fig.7